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Overview of Fuel Cycle Studies

GIF Policy & Experts Meeting: London
February 18-19, 2002

Generation IV

Fuel Cycle Crosscut Group (FCCG)

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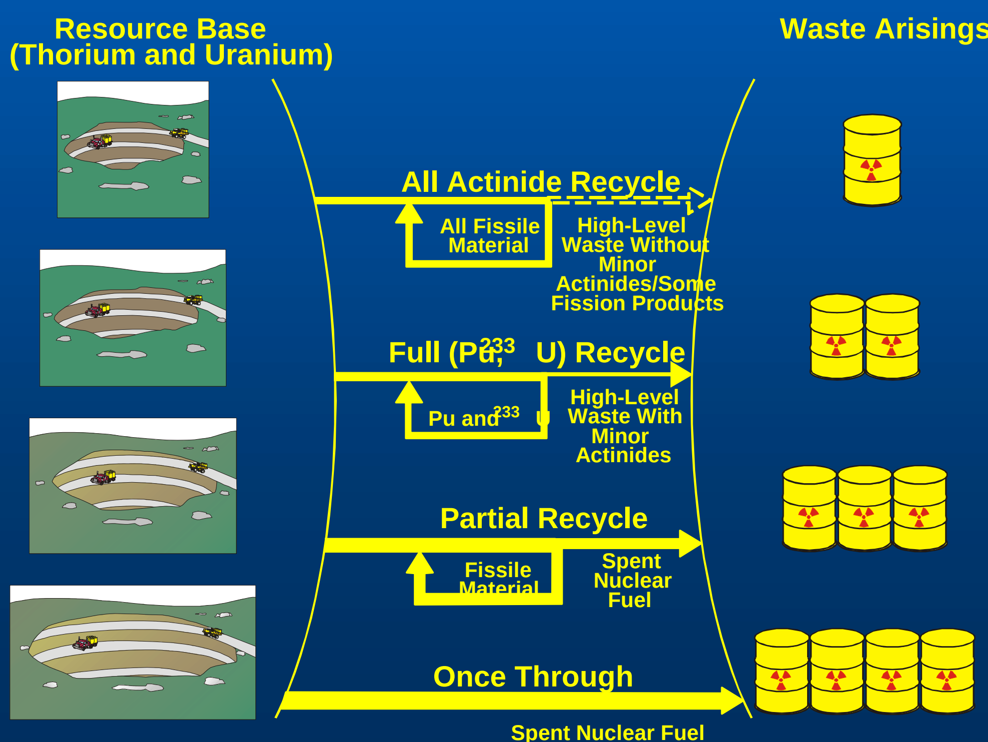
Gen IV Fuel Cycle Studies: Background

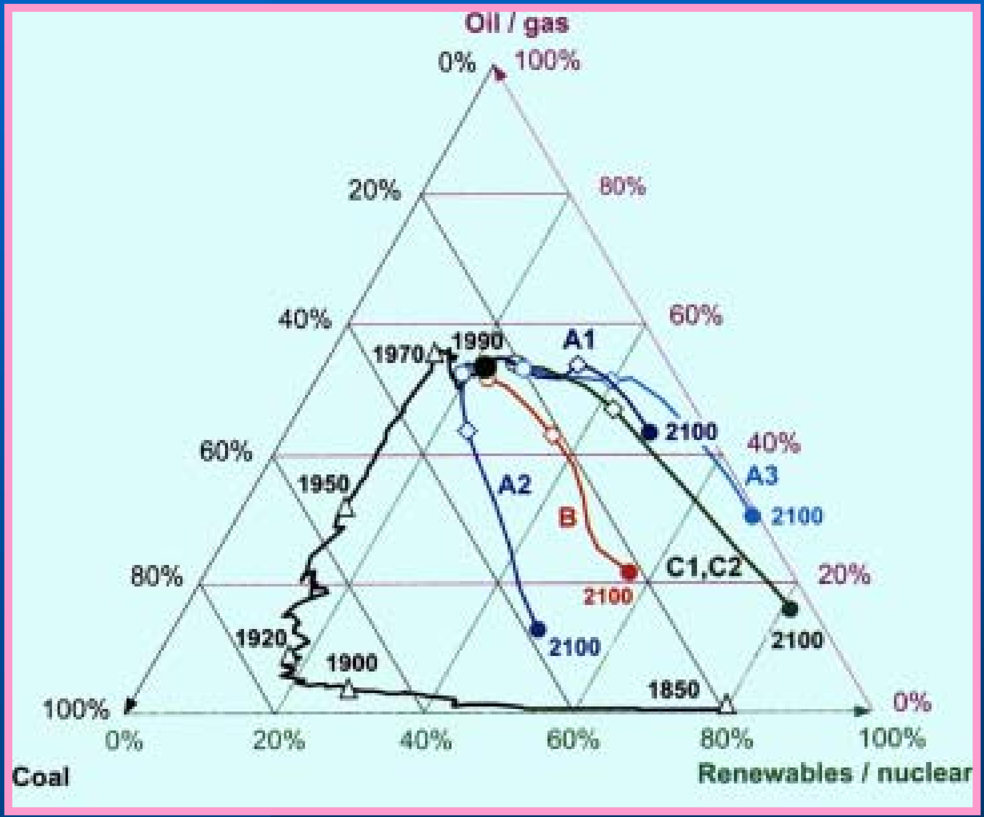
- *The Fuel Cycle Crosscut Group (FCCG) assessed the impact of fuel cycle options on key elements of sustainability:*
  - *Waste generation*
  - *Resource utilization*
- *Modeling over the next century was based on recent WEC/IIASA nuclear energy demand projections*
- *Four generic fuel cycle options were evaluated:*
  - *Once through (baseline case)*
  - *Limited Fissile Recycle*
  - *Full Fissile Recycle*
  - *Full Actinide Recycle*
- *A general 'symbiotic' option was evaluated, with a mix of thermal and fast reactors*

Major Fuel Cycle Options Studied

		Examples
Complete Recycle	*(Variable, Harvest U+Pu+MA)*	*Proposed IFR*
Multi Recycle	*(Variable, Harvest U+Pu)*	*Proposed EFR*
Mono Recycle	*(Net TRU Producer, Partial Harvest U+Pu)*	*European MOX*
Once through	*(Net TRU Producer, No Harvest)*	*LWR & CANDU Once Thru*



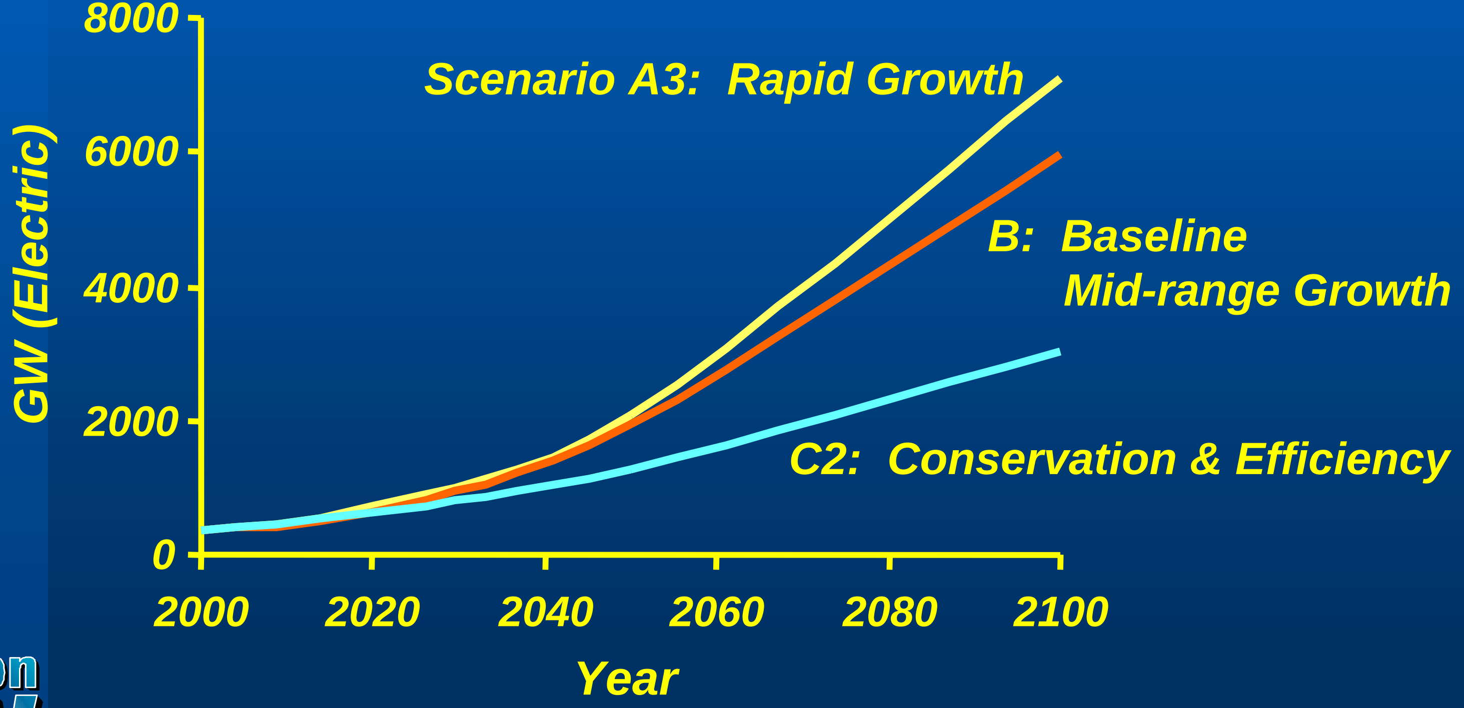
WEC/IIASA Energy Evolution Scenarios



- *A: Growth*
  - *A1 Oil*
  - *A2 Coal*
  - *A3 Renewables & Nuclear*
- *B: Reference (Middle course)*
- *C: Conservation*
  - *C1 Efficiency & Renewables*
  - *C2 Efficiency & Expanded Nuclear*

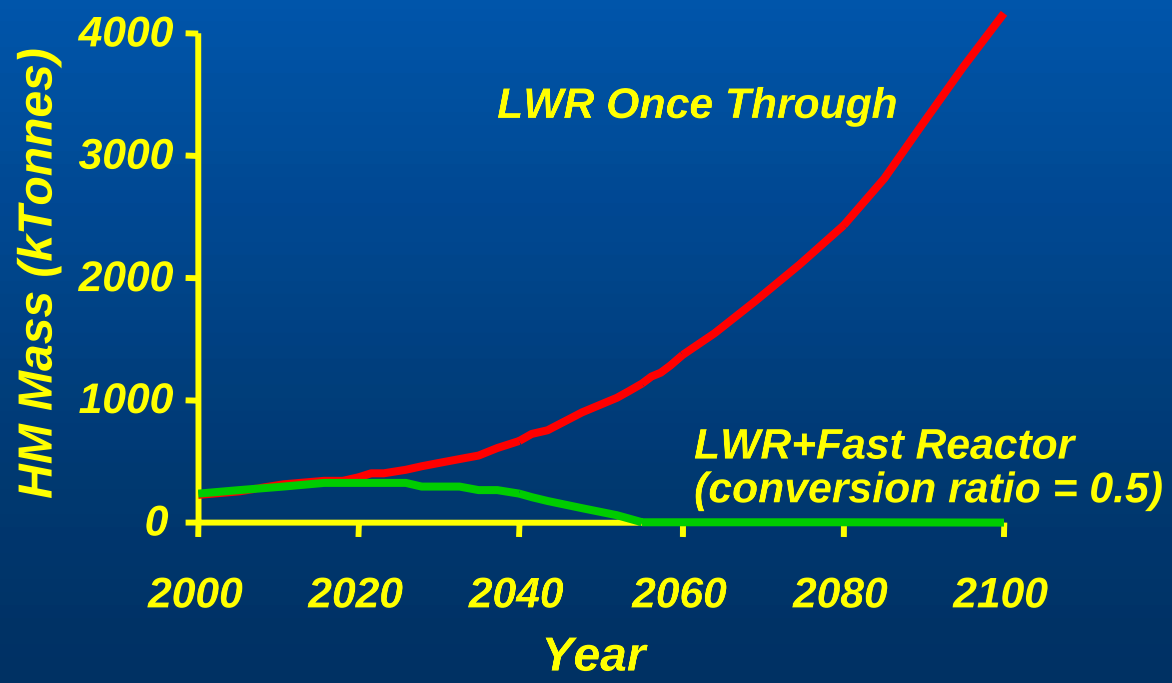
Fuel Cycle Study: Basic Scenarios

- *Cases B and C2 were explored*
- *Conclusions of both cases are similar*



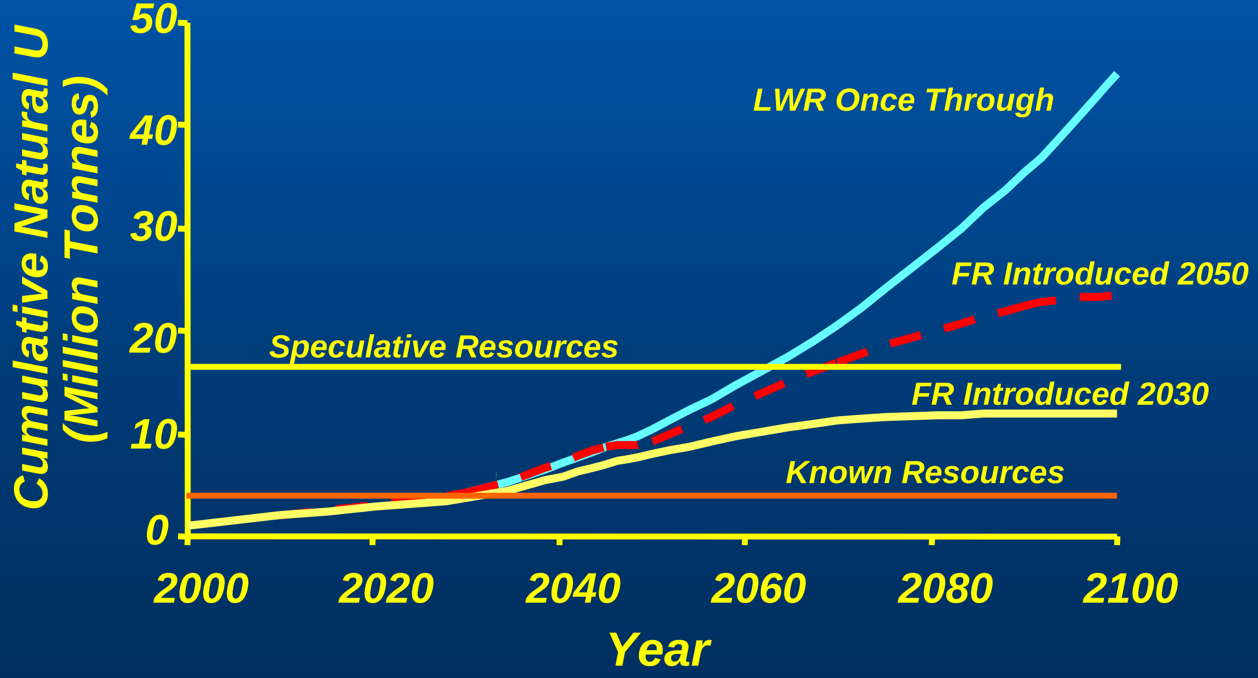
Fuel Cycle Study: Spent Fuel Inventory

- *Closing the fuel cycle has major impact*
- *For comparison, Yucca Mtn. capacity is 70 kTonnes*



Fuel Cycle Study: Resource Extension

- *Closing the fuel cycle again has major impact*
- *Resources may be extended for 1000 y*



Fuel Cycle Studies: Major Findings

- *Use of the once–through cycle leads to:*
  - *Accelerating repository siting needs*
  - *Exhaustion by mid-century of known + speculative high-grade ore*

- *Closing the fuel cycle achieves:*
  - *Reduced waste quantity and radiotoxicity*
  - *Waste forms optimized for durability and leach resistance*
  - *Optimal use of repository capacity through better decay heat management (100 y storage)*
  - *Resource extension via regeneration of fissile material*

- *A symbiotic mix of fast and thermal reactors is needed to limit waste disposal challenges and reduce overall system cost*

Generation IV